# SUMMARY AND CONCLUSIONS

Guizotia abyssinica Cass., commonly known as niger is one of the minor oilseed crop in India with total area of 4.6 lakh hectare under cultivation. The seed yields about 37-43 % oil. The oil is used for culinary purposes, for anointing the body, for manufacturing paints and soft soaps, for lighting and lubrication and for manufacturing cosmetics. The oilcake is a well known cattle feed. Due to the fact that niger belongs mainly to developing countries like India, not much attention has been paid to physiology of this crop in the past. In last few years there are a few attempts in this direction. The worth mentioning among them are of Abebe (1975), Rajput and Gupta (1978) and Patil (1979). However there is no definite co-ordination between these investigations and hence no clear picture of the physiological processes in niger emerge from these attempts. Hence in the present investigation preliminary physiological studies have been carried out. These studies are mainly aimed at fate of various inorganic and organic constituents during different growth conditions.

The analysis of organic constituents during different growth stages showed that there are marked changes in level of various organic constituents as the growth proceeds. The organic acid content of leaf as revealed by TAN values steadily increases along with growth of the plants. This can reflect increase in respiratory rate along with growth. The polyphenol accumulation in leaves however does not follow any definite pattern. The chlorophyll content goes on increasing upto

flowering of niger and thereafter a considerable decline in chlorophylls is observed. This can be well correlated with photosynthetic efficiency of niger. The high chlorophyll a/b ratios recorded in niger are indicative of its $C_3$ nature (Holden, 1973). Nitrogen uptake also increases upto flowering stage and thereafter there is a slight decrease. The accumulation of nitrogen was found to be more pronounced in leaf part than in stem or roots at later growth stages. The plant possesses good potential for nitrogen uptake. The carbohydrate accumulation in niger plants also followed similar trend and more total carbohydrates were recorded at flowering stage. An interesting point emerged out of this study is considerable accumulation of starch in the roots and it is quite probable that such high starch level can contribute to post stress recovery.

The study of uptake of phosphorus during different growth stages revealed maximum phosphorus content on a plant basis at flowering stage. The phosphorus contents in the niger leaves are always higher than those in roots. The potassium uptake also followed identical pattern. A marked potassium accumulation in stem of niger plant at all growth stages was evident in the present studies. Niger possesses ability to take up ample amount of potassium and potassium level recorded in it is quite above optimum level (1 % of dry weight) of potassium suggested by Epstein (1972). This is quite significant in view of various roles played by potassium in plant metabolism. As against potassium uptake, calcium content of niger plant increases with

plant age indicating thereby passive uptake of this element. It was further noticed that niger roots mainly function in absorbing calcium and transporting it to the aerial parts. The analysis of magnesium content in different parts of niger plant at various growth stages revealed that there is no definite pattern of magnesium accumulation during growth and magnesium tends to accumulate in roots. There is continuous increase in iron content along with age of the plant. However the site of iron accumulation appears to be roots which closely agrees with the suggestion (Mengel, 1972), regarding immobility of this micronutrient. Manganese accumulation during niger growth follows similar pattern. The very low contents of manganese recorded in niger stem are worth mentioning and it needs further probe to find adequate reasons for the same. In last few years a great importance has been attributed to silicon particularly in physiological processes of cereals like rice. In niger silicon goes on accumulating as the growth proceeds. Silicon tends to accumulate in roots during early growth stage and latter on it accumulates in the leaves. But the silicon contents in niger plant are far below those recorded for other graminae members like rice. The sodium contents in niger plant parts are found to be very low which indicate nonessentiality of this element for various metabolic processes. Thus like other crop species, in niger also, we can notice a peak of physiological activity near flowering stage.

The study of biochemical changes during senescence of niger leaves also revealed several interesting findings. The senescence was accompanied by considerable decline in chlorophylls with very little change in chlorophyll a/b ratios. The senescent leaves of niger contain relatively more organic acids than the mature ones indicating predominance of catabolic processes. A considerable decline in nitrogen and cylic amino acid proline was evident in senescent leaves which clearly support the concept that nitrogen in form of amino acids is retranslocated to young parts. The carbohydrate level (especially reducing sugars) was however found to be higher in senescent leaves. The senescence of niger leaves is further accompanied by decrease in potassium, phosphorus and magnesium contents and accumulation of calcium, silicon, iron, manganese and sodium contents. This can be correlated with mobility properties of these elements in plant system. Further the analysis reveals prominent tendencies of retranslocation of essential elements like potassium, phosphorus and magnesium to the developing parts. Thus in senescent niger leaves an overall change in organic and inorganic balance is noticed which in turn can affect other physiological processes. This is well reflected in our photosynthetic studies with $^{14}C$ technique. A considerable decline in photosynthetic efficiency of senescent leaves was evident.

As niger is regarded as one of the sturdy crops, a preliminary study was undertaken to evaluate the physiological responses of this plant to water stress. It was observed that

the niger leaves possess good water retention capacity (about 40% water at 8 days stress) which can add to drought resistance capacity of the plant. The polyphenol content increases due to water stress and this may reflect induction of secondary metabolism. The water stress caused accumulation of total nitrogen in leaves and roots of niger plants which indicate that the plant possesses good capacity for nitrogen uptake even under water stress. The proline content increased considerably in water stressed niger leaves and this can be considered as one of the important adaptive features. The water stress caused lowering of chlorophyll content in niger leaves. However, the leaves retain about 40 % chlorophyll even under severe stress which can undoubtedly play important role in drought resistance mechanism. The organic acid level in water stressed niger leaves was significantly high and organic acids can probably play a role in osmotic adjustment. Water stress caused increase in reducing and nonreducing sugars in niger leaves which reflect a change in carbohydrate metabolism due to drought. The analysis of inorganic constituents revealed that water stress lowered the contents of phosphorus, magnesium, silicon, manganese and iron in different plant parts. This can adversely affect the plant metabolism. Accumulation of potassium, calcium and sodium in water stressed plant was observed. In view of the role played by potassium in drought resistance processes (Mengel and Kirkby, 1980), it appears

that accumulation of potassium in niger under water stress may be an adaptive feature.

In conclusion it can be said that there are considerable changes in the pattern of inorganic and organic constituents during different growth phases of niger plant and leaf senescence. The metabolism of niger plant is also influenced by environmental factors like availability of water. Like other crops niger also possesses good ability of nutrient uptake and translocation of essential elements during senescence, accumulation of proline, organic acids and potassium under water stress are suggestive of adaptive ecological nature of the niger plant.